

What is claimed is:

1. A method of forming a tiered structure using a multi-layered resist stack comprising the steps of:

- 5 providing a substrate having a surface;
 depositing and patterning a base resist layer on the surface of the substrate;
 stabilizing the patterned base resist layer, thereby forming a stabilized resist layer;
10 depositing a resist stack on an uppermost surface of the stabilized resist layer;
 patterning, in alignment with an opening defined in the stabilized resist layer, an opening in the resist stack having a reentrant profile and a dimension greater than the opening defined in the stabilized resist layer;
15 depositing a metal material within the opening defined therein the resist stack and the opening defined therein the stabilized resist layer; and
 removing the resist stack and the stabilized resist layer, thereby exposing a tiered structure.

- 20 2. A method of forming a tiered structure using a multi-layered resist stack as claimed in claim 1 wherein the tiered structure is a T-gate structure.

3. A method of forming a tiered structure using a multi-layered resist stack as claimed in claim 2 wherein the step of providing a substrate having a surface includes providing a substrate formed of a semiconductor material.

5 4. A method of forming a tiered structure using a multi-layered resist stack as claimed in claim 3 wherein the step of depositing a base resist layer includes depositing a low to medium molecular weight, soluble, organic imageable material.

10 5. A method of forming a tiered structure using a multi-layered resist stack as claimed in claim 3 wherein the step of stabilizing the patterned base resist layer includes the step of exposing the base resist layer to one of a heat source, a light source, a heat source and a light source, an electron beam irradiation source, and an electron beam irradiation source and a heat
15 source, thereby increasing the molecular weight of the base resist layer through cross-linking, forming the stabilized base resist layer.

6. A method of forming a tiered structure using a multi-layered resist stack as claimed in claim 5 wherein the step of exposing the base resist layer
20 to a light source includes exposing to an deep ultraviolet light source.

7. A method of forming a tiered structure using a multi-layered resist stack as claimed in claim 5 wherein the step of depositing the resist stack on

an uppermost surface of the stabilized resist layer includes forming a multiple layer resist stack.

8. A method of forming a tiered structure using a multi-layered resist stack as claimed in claim 5 wherein the step of depositing a metal material includes depositing a conductive metal material.

9. A method of forming a tiered structure using a multi-layered resist stack as claimed in claim 5 wherein the step of removing the resist stack and the stabilized base resist layer includes immersing the stack in a solvent bath immersion to remove the resist stack and etching to remove the stabilized base resist layer.

10. A method of forming a tiered structure using a multi-layered resist stack comprising the steps of:

providing a semiconductor substrate having a surface;

depositing a soluble organic imageable material on the surface of the substrate, thereby forming a base resist layer;

patterning the base resist layer to define therein an opening having a first dimension;

stabilizing the base resist layer by exposing the base resist layer to one of a light source, a heat source, a combination of a light source and a heat source, an electron beam irradiation source, and a combination of an electron

beam irradiation source and a heat source, thereby increasing the molecular weight of the base resist layer through cross-linking and forming a stabilized resist layer having an opening defined therein;

forming a resist stack including an isotropically developing material
5 formed on an uppermost surface of the stabilized resist layer and an
imageable material formed on a surface of the isotropically developing
material ;

patterning, in alignment with an opening defined in the stabilized resist
layer, an opening in the imageable material and an opening in the
10 isotropically developing material having a reentrant profile and a dimension
greater than the opening defined in the stabilized resist layer;

depositing a metal material within the openings defined therein the
resist stack and the opening defined therein the stabilized resist layer; and

removing the resist stack and the stabilized resist layer, thereby
15 exposing a tiered structure.

11. A method of forming a tiered structure using a multi-layered resist
stack as claimed in claim 10 wherein the tiered structure is a T-gate structure.

20 12. A method of forming a tiered structure using a multi-layered resist
stack as claimed in claim 10 wherein the step of providing a substrate having
a surface includes providing a substrate formed of a semiconducting material
chosen from the group consisting of: column III-V compound semiconductors,

glass, metals, silicon.

13. A method of forming a tiered structure using a multi-layered resist stack as claimed in claim 10 wherein the step of depositing a base resist layer
5 includes depositing a low to medium molecular weight soluble organic imageable material.

14. A method of forming a tiered structure using a multi-layered resist stack as claimed in claim 10 wherein the step of exposing the base resist
10 layer to a light source includes exposing to a deep ultraviolet light source.

15. A method of forming a tiered structure using a multi-layered resist stack as claimed in claim 10 wherein the step of depositing a resist stack on an uppermost surface of the stabilized resist layer includes the step of
15 creating a reentrant resist profile in the upper resist layer by diffusing a base into an uppermost portion of the resist stack, and defining an isotropically developed material adjacent the stabilized resist layer.

16. A method of forming a tiered structure using a multi-layered resist
20 stack as claimed in claim 10 wherein the step of depositing a metal material includes depositing a conductive metal material.

17. A method of forming a tiered structure using a multi-layered resist

stack as claimed in claim 10 wherein the step of removing the resist stack and the stabilized resist layer includes immersing the stack in a solvent bath immersion to remove the resist stack and etching to remove the stabilized resist layer.

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18. A method of forming a semiconductor device comprising the steps of:

providing a substrate having a surface;

forming a source on an uppermost surface of the substrate;

10 forming a drain on an uppermost surface of the substrate;

fabricating a tiered structure including the steps of:

providing a substrate having a surface;

depositing and patterning a base resist layer on the surface of the substrate;

15 stabilizing the patterned base resist layer, thereby forming a stabilized resist layer;

depositing a resist stack on an uppermost surface of the stabilized resist layer;

20 patterning, in alignment with an opening defined in the stabilized resist layer, an opening in the resist stack having a reentrant profile and a dimension greater than the opening defined in the stabilized resist layer;

depositing a metal material within the opening defined therein

the resist stack and the opening defined therein the stabilized resist layer; and

removing the resist stack and the stabilized resist layer, thereby exposing a tiered structure; and

5 positioning the tiered structure between the source and the drain, thereby forming a transistor.

19. A method of forming a semiconductor device as claimed in claim 18 wherein the step of depositing a base resist layer on the surface of the substrate includes depositing a low to medium molecular weight, soluble,
10 organic imageable material.

20. A method of forming a tiered structure using a multi-layered resist stack as claimed in claim 19 wherein the step of stabilizing the patterned
15 base resist layer includes the step of exposing the base resist layer to one of a heat source, a light source, a combination of a heat source and a light source, an electron beam irradiation source, and a combination of an electron beam irradiation source and a heat source, thereby increasing the molecular weight of the base resist layer through cross-linking and forming the stabilized
20 resist layer.

21. A method of forming a tiered structure using a multi-layered resist stack as claimed in claim 20 wherein the step of exposing the base resist

layer to a light source includes exposing to a deep ultraviolet light source.

23. A method of forming a tiered structure using a multi-layered resist stack as claimed in claim 20 wherein the step of removing the at least one resist layer and the stabilized resist layer includes immersing the stack in a solvent bath immersion to remove the at least one resist layer and etching to remove the stabilized resist layer.